Living Shoreline:
Collins Cove & Forest River

GPH: 343 Drones Application
Salem State University
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Climate change can be represented in a large variety of phenomena including glacial melt, sea level rise, weather anomalies, ocean temperatures warming and becoming more acidified. One of the many consequences of climate change is the rise of sea levels, which is a particular threat to coastlines. Due to both the melting of ice sheets and the thermal expansion of water, the rate of sea level rise has risen in the past century from 1.4mm/year to 3.6mm/year. These numbers add up to serious environmental harm, including flooding, erosion, and saltwater intrusion. In order to adapt to sea level rise, it is crucial to maintain our coastline vegetation, which acts as a buffer against storm surges.

Living shorelines are considered coastal areas filled with rocks, wetland plants, and sand in order to prevent erosion and stabilize shorelines. Research has shown that retaining walls and hardened structures along shorelines can actually cause more erosion while trying to prevent it (Living Shorelines). The city of Salem has implemented living shorelines in two separate coastal locations to try to prevent degradation of the shorelines. Living shorelines provide a habitat for animals who live in these areas, and also improve water filtration from run-off.

The first part of our drone project will focus on the living shoreline at Forest River Park, in Salem, Massachusetts. Forest River Park has a view of the harbor, bike path, picnic area, two beaches, a playground, swimming pool, a

baseball field, and a concrete slide you can slide down with cardboard. The Park is also home to a Pioneer Village, a 17th century fishing village. Established in the 1930s this is America's first living history museum.

The second part of our drone project will be focused on the living shorelines at Collins Cove and Forest River Park in Salem, Massachusetts. Collins Cove, a 500-foot-long stretch of sandy beach, is a small inlet off Salem Harbor. (Briscoe 2023) Here you can picnic, swim or sunbathe while taking in the beautiful coastline views. In 2019 restoration of the living shoreline began after analyzing the erosion rate and storm surge vulnerability. We would like to measure the rate of growth of the newly planted vegetation as well as the sediment levels. Summer and Fall will be the best time to study vegetation health at this site. Winter and spring will be a good time to see the sediment levels.

The two research goals of this project:

- Are to determine the sediment change of the nearby beach compared to the living shoreline
- To monitor the vegetation health of the living shore line

The drone will be the best way to observe the sediment and vegetation at Collins Cove and Forest River because with a drone we can take a multitude of pictures and videos at an aerial view. We can set parameters with the drone to create imagery that will be easier to analyze than satellite imagery. These areas host many visitors, and both are bordered by bike paths that have frequent walking/running/biking visitors. While flying drones in these places we have to be cautious and respectful of these people. Collins Cove is also nearby a school, and is amidst a neighborhood which should be taken into consideration as well. We can be a mindful consumer of drone technology by not flying near house windows, respecting people's privacy and private property. Being mindful of the drone local and state drone laws. Have the drone registered and have proper safety equipment on the drone.

The first drone flight will be at Forest River Park, a 150 ft living shoreline in Salem, Massachusetts. This flight will be in 2D and Multispectral. Our scene is coastal so there can be increased wind speeds coming off of the ocean that could influence our flight. The elevation of the flight is 150 feet therefore our pixels are bigger, approximately 1-2 centimeters, which could cause increased difficulty when we try to examine the vegetation on the shoreline. We are also examining the sand, soil, and sediments so it is helpful to fly during low tide. The flight information we already have is from high-tide, which could cause some

problems when analyzing the imagery. This flight had 85% forward 75% horizontal overlap.

The second drone flight will be at Collins Cove, a small coastal inlet about 500 ft in length in Salem, Massachusetts. Collins Cove is a public park with a bike path, which could pose issues with civilians. This flight will be 2D and Multispectral. The elevation of this flight is 72 meters and our pixels will be sub-centimeter in order to gather as much detail as possible. There will be a 90% forward and 70% horizontal overlap. The ideal time to fly would be low tide, or at least low enough that all the vegetation is exposed.

https://docs.google.com/spreadsheets/d/1br90URyiQnezOu-usXtcNElGldiSsIzzv7EKjPgH14w/edit?usp=sharing

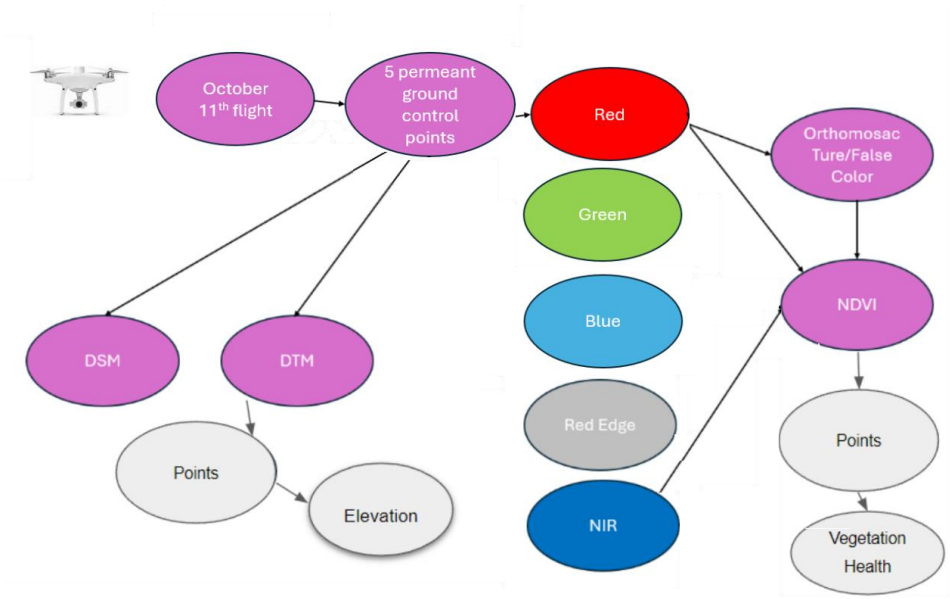
	Drone	Scene/Feature	Good fit? (Yes/No)
Spatial Extent	Living Shore line, salt water, planted vegetation, rocks, sand,	Collins Cove: 0.65 acres Forest River: 0.38 acres	YES

Spatial Resolution (Individual)	Collins Cove: 73m sub-centimeter Forest River: 45.72m (150ft) 1-2 cm pixels	0.5in - 36in	YES
Important Sensor Bands/Products	RGB, Red Edge, NIR, IR, DTM	NIR, RGB, InfraredTHis	YES
Temporal Resolution	Yearly	End of summer/early fall, low tide, before hurricane season	YES
Necessary Accuracy	Sub-Meter estimation	Absolute Accuracy	YES

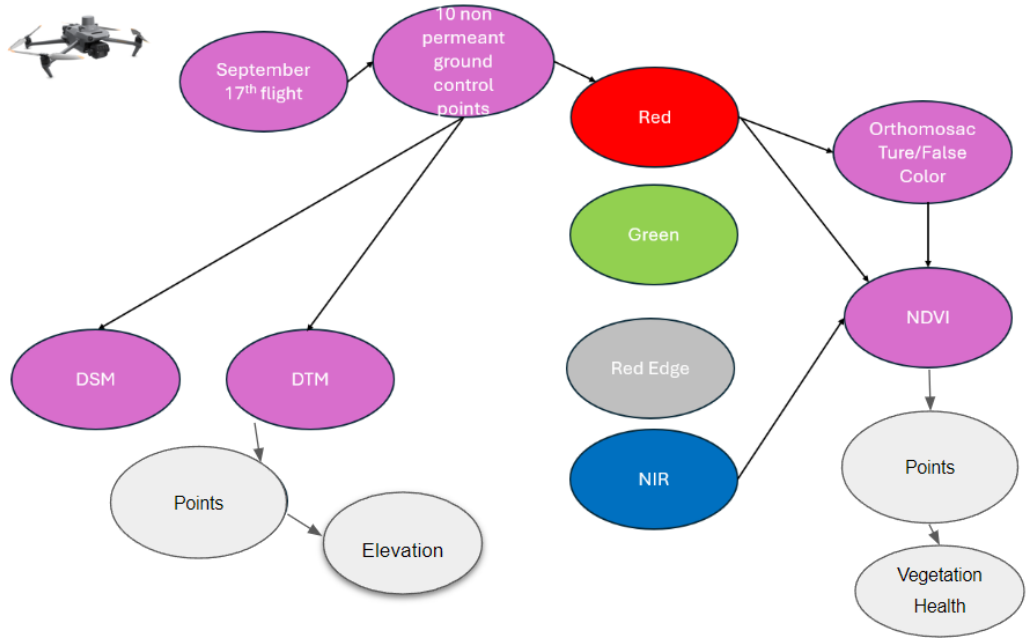
For our flight at Forest River Park, we used the Mavick 3 M drone. We flew at a height of 150 ft and collected 356 images. Preferably we will fly in conditions that are not too windy, in the early fall before hurricane season, during low tide. We used the red, green, near infrared and red edge sensors during our flight. With this data we will create Orthomosaic, NDVI, NDVIE, and DTM. We utilized 10 non-permanent ground control points in this flight. We hope that our analysis will help show the vegetation health and impact that the living shoreline has had on the erosion at Forest River Park.

The methods for the Collins Cove flight will include flying the Phantom Four MultiSpectral Drone at a height of 73 meters. We will be using the Red, Green, Blue, Near infrared and Red edge sensors to capture aerial imagery. We will be using this imagery to create Orthomosaic, True and False Color composite maps. The best time of year to fly to see the vegetation's health is in Fall. Ideally we will be continuing to fly each fall to keep the data consistent.

Collins Cove Methods Diagram



Forest River Methods Diagram



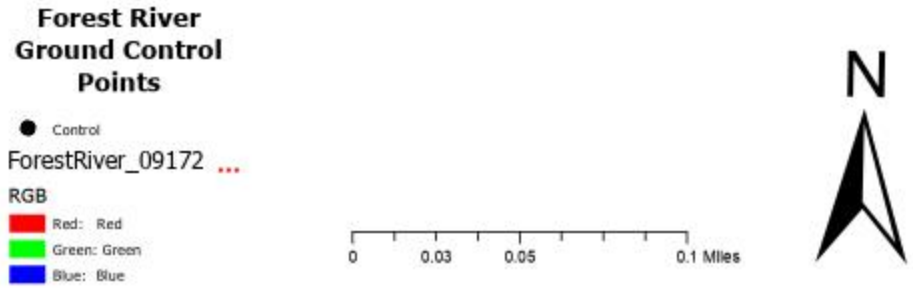
(*Living Shorelines*, 2022)

Collins Cove: Ground Control Points

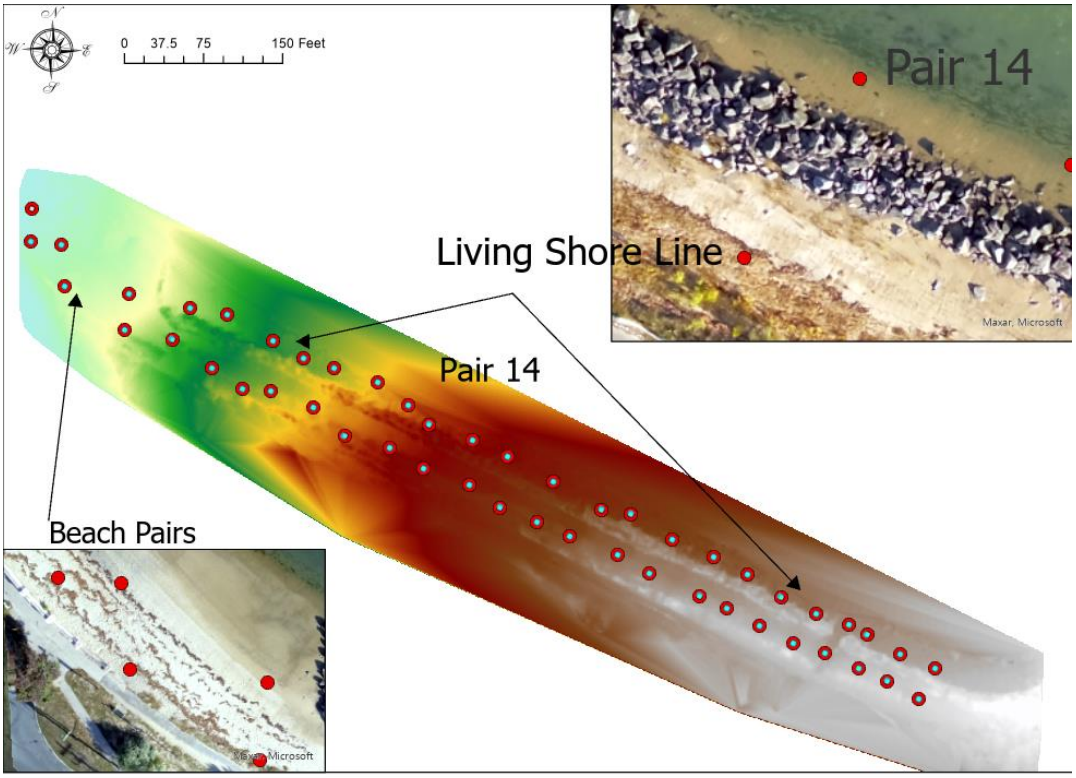
"Z:\UGrad\gph343\Personal\Otting\Final_Project\Collins_Cove_Final\CollinsCoveGCPMap.pdf"

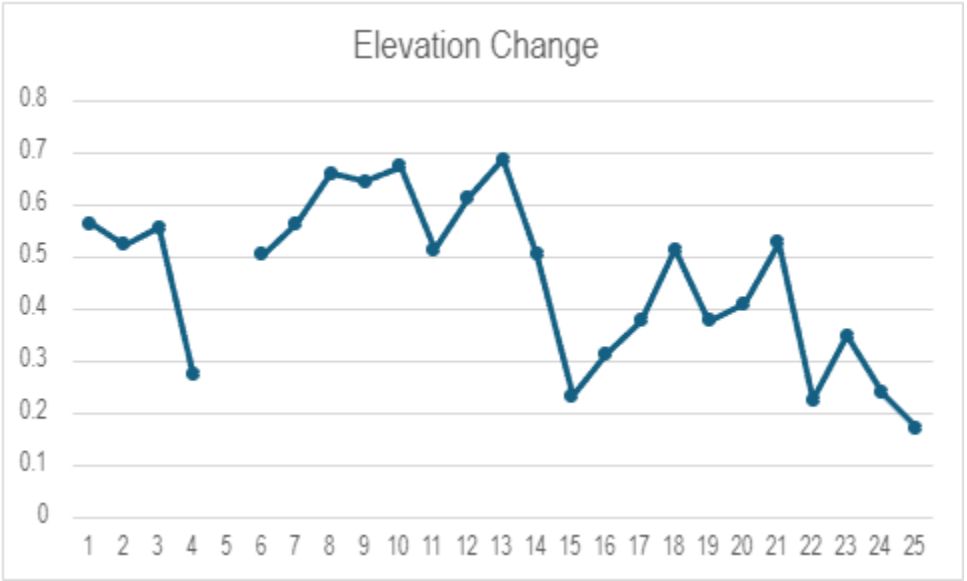
Forest River: Ground Control Points

"Z:\UGrad\gph343\Personal\Nickerson\Lab2\lab2 question 7\ForestRiverGroundControlPoints.pdf"



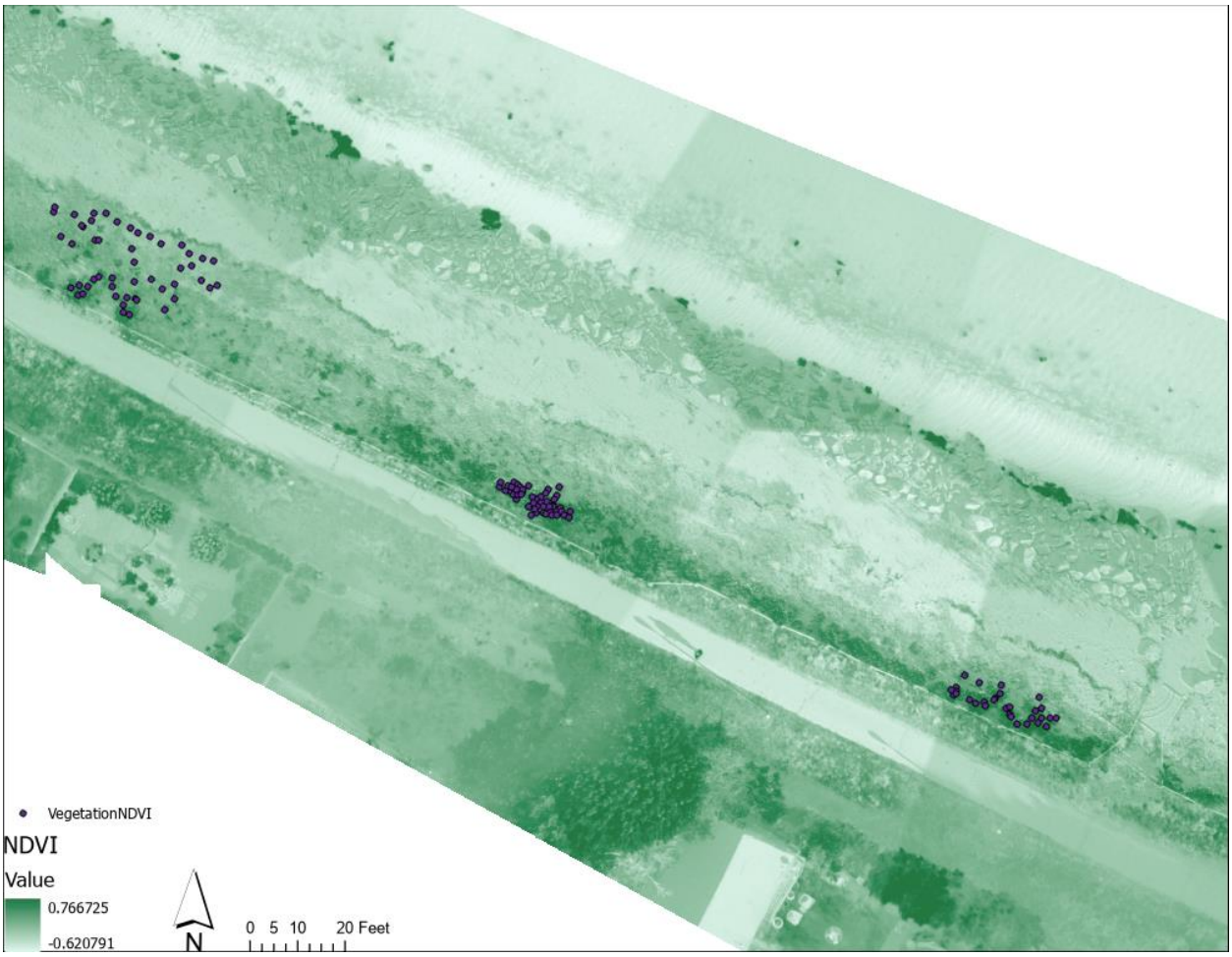
Collins Cove DTM

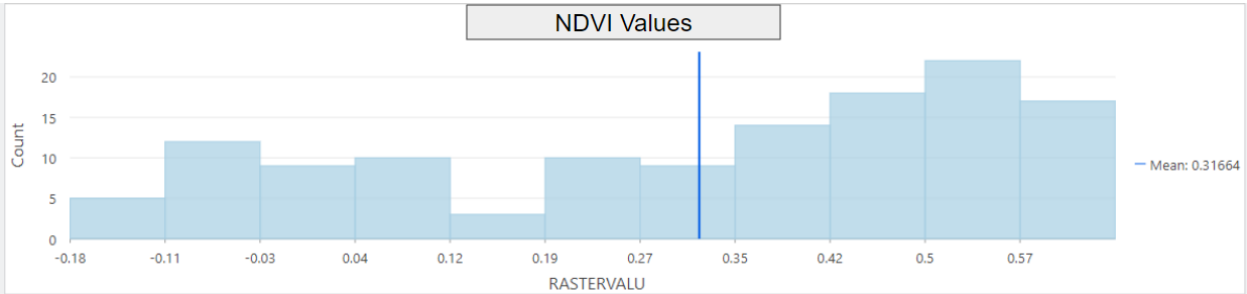




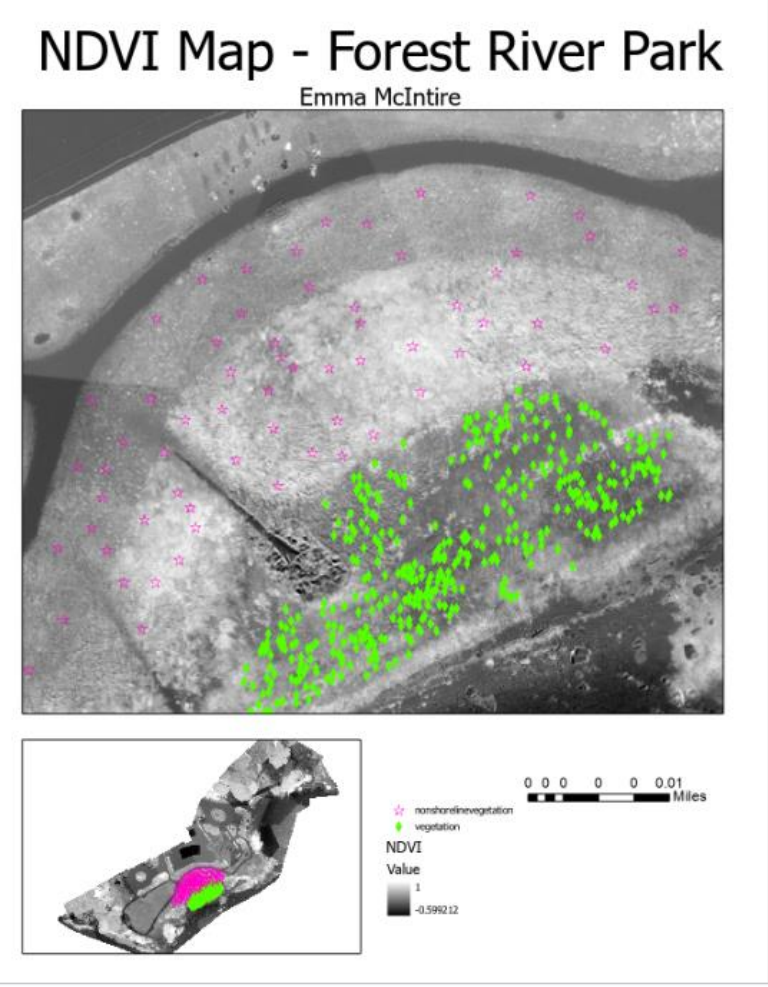
Class	Average of difference	Count of difference
Beach	0.25988075	4
Living	0.5012253	20

Collins Cove NDVI

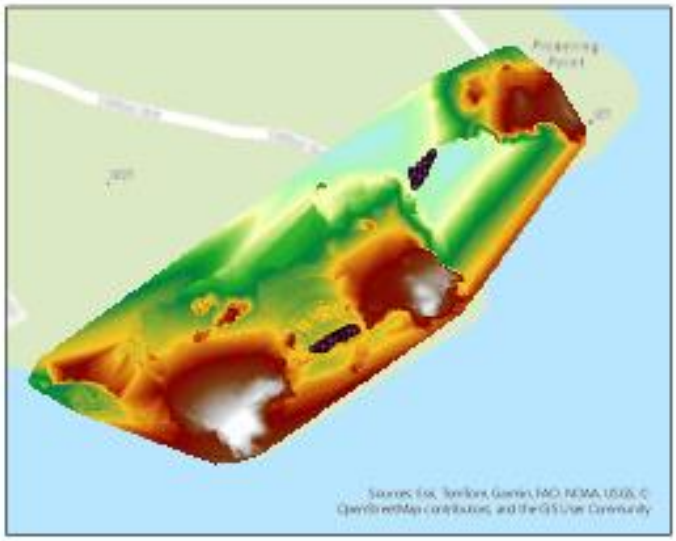


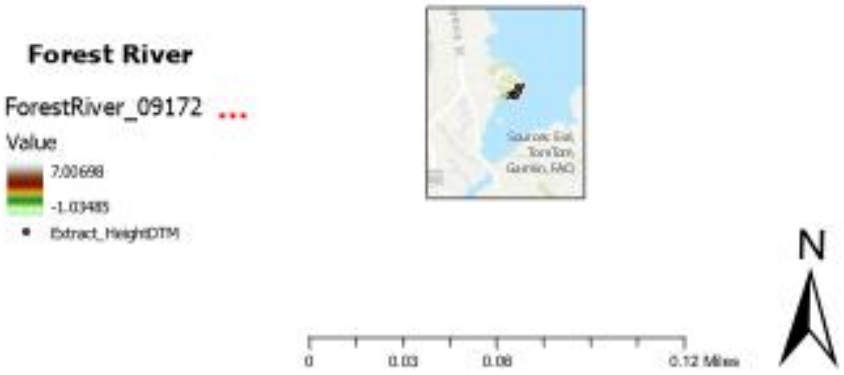


Forest River NDVI



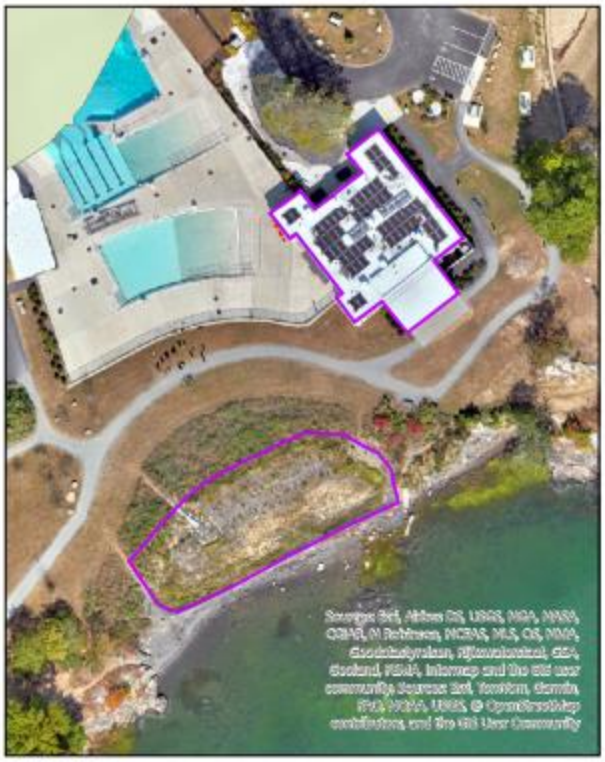
Forest River DTM





Collins Cove: Study Area Map

Forest River: Study Area Map



Forest River
Study Area Map

Line Notes
Line Notes

ForestRiver_09172

RGB

Red: Red
Green: Green
Blue: Blue

0 0.01 0.01 0.03 Miles

N

Conclusions

Collins Cove:

Vegetation has low NDVI in October. The sediment is showing signs of maintaining current elevation. There is more elevation on the living shore line by 25 centimeters on average. Next level of analysis would be to compare previous years drone footage. Based on our analysis we feel that the goal of the living shore line is being met. The banks are showing more stabilization and less erosion than the beach area without a living shore line.

Forest River:

Based on the NDVI values, it does not appear the shoreline is in its healthiest or greenest state. This could be due to the drought the city experienced earlier this year, or other factors. Based on the digital terrain model we created, we can see that the beach elevation is higher than the shoreline, leading us to believe that the shoreline may not necessarily be preventing erosion.

Sources

Briscoe, William. “Collins Cove Beach in Salem, Massachusetts - Mass Attractions.” *Mass Attractions*, 15 Aug. 2023, massattractions.com/collins-cove-beach-salem-ma/. Accessed 22 Oct. 2024.

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Living Shorelines - Salem Sound Coastwatch